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SHORT COMMUNICATION

Coagulation of Natural Rubber: Effect of Pycnanthus Angolensis *(Welw.) Warb. (Myristicaseae) on Some Raw Rubber Properties*

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An investigation of the effects of Pycnanthus angolensis *(Welw.) on some raw rubber properties is reported. The Wallace plasticity and plasticity retention index of* Pycnanthus angolensis *coagulated rubber are compared with those of formic acid coagulated rubber. The dry rubber content, ash content and nitrogen content of* Pycnanthus angolensis *coagulated rubber compare favourably with those of formic acid coagulated rubber. A 40% (volume/volume) mixture of* Pycnanthus angolensis *sap and formic acid produced rubber with improved plasticity retention index.*

The steady increase in the cost of chemicals, materials and equipments[1] all of which are imported into Nigeria, largely explains the deficit in the level of rubber production with the Government's investments. This short communication is part of a continuing study into the development and use of local materials as coagulants for natural rubber; and examines the effect of *Pycnanthus angolensis* on some raw rubber properties.

EXPERIMENTAL

Materials

Natural rubber latex was obtained from the Rubber Research Institute of Nigeria, Iyanomon – Benin City. It was sieved before use. The latex used in this investigation was obtained from the same clone of *Hevea brasiliensis*.

Formic acid solution (2% volume/volume) was used in the coagulation experiments. *Pycnanthus angolensis* sap was obtained through the Rubber Research Institute of Nigeria, Iyanomon – Benin City. The reddish liquid (pH = 7.2) was sieved and stored at 7°C until required for coagulation experiments.

Coagulation of Natural Rubber Latex

The coagulation of natural rubber latex was carried out with 2% formic acid solution, *P. angolensis* sap and a mixture of *P. angolensis* sap and formic acid. Various amounts of the coagulants were added into well stirred latex (100 ml) at room temperature. The rate of coagulation was measured by the time required for the latex to solidify. The coagulants were washed several times in distilled water and the dry rubber contents were determined.

Dry Rubber Content

The Standard Laboratory Method[2] was used to determine the dry rubber content

(d.r.c.) of the coagulum. The coagulum was allowed to drip dry and it was weighed and placed in a thermostatically controlled oven at 120°C ± 0.1°C for 3 h. The dry rubber was cooled in a desiccator and weighed. The d.r.c. was calculated from the weights before and after drying in the oven. The dry rubber was milled to a thickness of about 2 mm.

Initial Wallace Plasticity

The Wallace Plasticity, P_o, of the milled rubber was measured with a Rapid Wallace Plastimeter using three different portions of the same rubber sample to ensure reproducibility.

Plasticity Retention Index

Samples of the milled rubber were heated in an oven at 140°C for 30 min and the plasticity P′ was measured. The plasticity retention index (PRI) was determined from the relationship:

$$PRI = (P'/P_o) \times 100$$

Ash Content

A weighed portion of the milled rubber was heated in a muffle furnace at 550°C for 3 h, allowed to cool in a desiccator and reweighed.

Dirt Content

A weighed portion of the milled rubber was dissolved in 100 ml of petroleum ether and boiled with a large excess of peptiser RRA_3. The hot rubber solution was filtered through an ASTM 325 mesh sieve. The sieve was dried in a desiccator, then at 150°C, and weighed before and after the dirt was washed off.

Nitrogen Content

The Kjeldahl method was used to determine the nitrogen content of the rubber samples.

RESULTS AND DISCUSSION

The variation of the rate of coagulation of latex with the amount of coagulant added is shown in *Figure 1*. The results indicated that *P. angolensis* coagulates latex at a comparable rate with formic acid.

Tables 1, 2 and *3* show the effect of the coagulants on the raw rubber properties. It would seem from the values of the d.r.c. in *Tables 1* and *2* that *P. angolensis* is generally more effective in coagulating latex. The PRI values of *P. angolensis* coagulated rubber compare favourably with those of formic acid coagulated rubber. One of the major problems with *P. angolensis* coagulated rubber is the reddish colour of the coagulant. It was thought that using a dilute mixture of *P. angolensis* sap in formic acid would

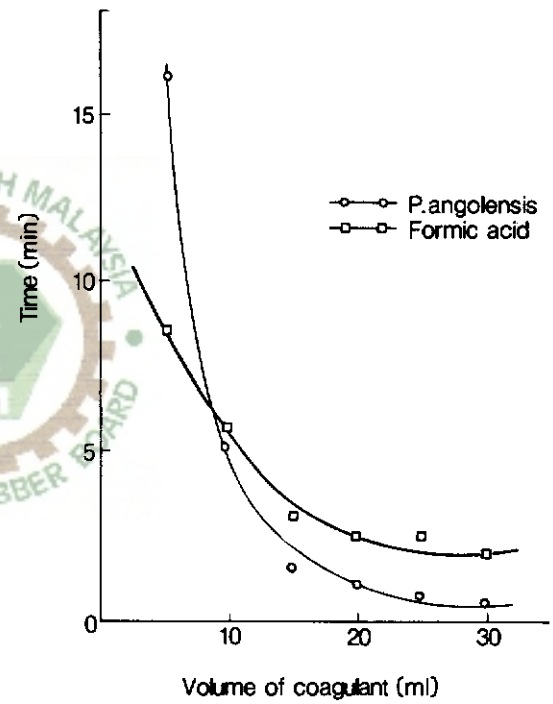

Figure 1. Variation of time of coagulation of latex with varying volumes of coagulant.

TABLE 1. PROPERTIES OF FORMIC ACID COAGULATED RUBBER

Volume of coagulant (ml)	D.r.c. (%)	P_o (%)	PRI (%)	Ash content (%)	N_2 content (%)	Dirt content (%)
5	35.0	–	–	–	–	–
10	36.4	32.3	92.8	2.5	0.4	2.2
15	36.7	30.7	93.3	2.4	0.5	2.3
20	37.6	30.3	93.3	2.4	–	–
25	39.9	–	–	2.4	0.3	2.3
30	46.5	30.0	93.3	2.4	0.3	2.3

TABLE 2. PROPERTIES OF *P. ANGOLENSIS* COAGULATED RUBBER

Volume of coagulant (ml)	D.r.c. (%)	P_o (%)	PRI (%)	Ash content (%)	N_2 content (%)	Dirt content (%)
5	38.0	–	–	–	–	–
10	39.1	45.0	92.6	2.6	0.5	2.6
15	40.0	–	–	–	–	2.8
20	41.7	45.0	93.0	2.8	0.4	3.1
25	46.4	45.1	92.7	3.9	0.4	3.2
30	50.0	45.3	92.9	4.0	0.4	3.7

TABLE 3. PROPERTIES OF RUBBER COAGULATED WITH A MIXTURE OF *P. ANGOLENSIS* AND FORMIC ACID

Percentage (v/v) of *P. angolensis*	D.r.c. (%)	P_o (%)	PRI (%)
80	37.4	35.0	85.6
60	38.2	35.0	86.6
50	37.6	34.7	89.4
40	38.7	38.0	98.3
20	42.0	37.7	96.6

reduce the colouration of the rubber. Though this method has limited success in reducing the colouration of *P. angolensis* coagulated rubber, it provides a means of looking into the properties of rubber coagulated with a mixture of *P. angolensis* and formic acid. *Table 3* shows the d.r.c. and PRI values of the dry rubber obtained from using various ratios of *P. angolensis* sap to formic acid. A maximum plasticity retention index value (98.3) was obtained for a 40% (volume/volume) mixture of *P. angolensis* sap and formic acid.

It is thought that the inherent chemical nature of *P. angolensis* sap would largely explain the results of this investigation. A report on the chemical analysis of *P. angolensis* sap and further studies on viscosity and mechanical properties of the rubber, which are presently in progress will be discussed in future communications.

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